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Remnant blocks of the Soldado Formation, not directly connected with Beds 1 and 2 . . . . .	378
Dasyclad algae limestone . . . . .	379
Unidentified fossiliferous limestone . . . . .	380
The Athecocyclina limestone . . . . .	380
The Ranikothalia limestone . . . . .	382
The Neodiscocyclina grimsdalei limestone . . . . .	384
Reworking of the Paleocene fauna into the younger sediments . . . . .	385
Occurrence of equivalents of the Soldado Formation . . . . .	385
Trinidad . . . . .	386
Other Caribbean islands, Venezuela and elsewhere . . . . .	386
B. The San Fernando Formation . . . . .	388
Bed 3 . . . . .	388
Bed 4 . . . . .	393
Bed 5 . . . . .	396
Bed 6 . . . . .	396
Bed 7 . . . . .	397
Bed 8 . . . . .	398
Bed 9 . . . . .	399
Bed 9a ("Asterocyclina marl") . . . . .	400
Bed 10 . . . . .	404
C. The Boca de Serpiente Formation . . . . .	411
Bed 11 . . . . .	411
D. Undetermined formation . . . . .	420
Bed 12 . . . . .	420
E. Miocene beds . . . . .	420
F. Recapitulation of the sample lists of various beds . . . . .	422
G. Annotations to the distribution chart . . . . .	426
H. Conclusions: the geological history of Soldado Rock . . . . .	427
Acknowledgments . . . . .	430
References . . . . .	430

## Introduction

The Soldado Rock stands sentinel in the strong tidal currents of the shallow Southern passage, called the Serpent's Mouth, between Trinidad and the South American mainland, about 10 kilometers West of Columbus Bay on the Cedros Peninsula.

The Rock comprises an area of about 6500 square meters. From its Northern point, which carries the trigonometrical signal, and which is 36 meters above sea level, one can see the flat Pedernales area at the Northern end of the Orinoco delta. The coordinates of this point are: Latitude  $10^{\circ} 04' 24''$ , Longitude  $62^{\circ} 00' 56''$ . To the South of the highest point there follows a saddle of softer beds and then another, lower, elevation. During the breeding season the intruder is greeted by the shrieks of terns and other guano producing birds. The guano and its resulting phosphate of lime cover the island from the top to the high-water level.

Though Amerindians, and later on fishermen of Trinidad, regularly collected eggs during the breeding season of the terns, one cannot expect anyone to visit the inhospitable Soldado Rock excepting biologists, surveyors and geologists. The first geologist to have visited Soldado Rock known to us was V.C. Veatch, whose collection of fossil shells, together with some stratigraphic details, was described by MAURY in

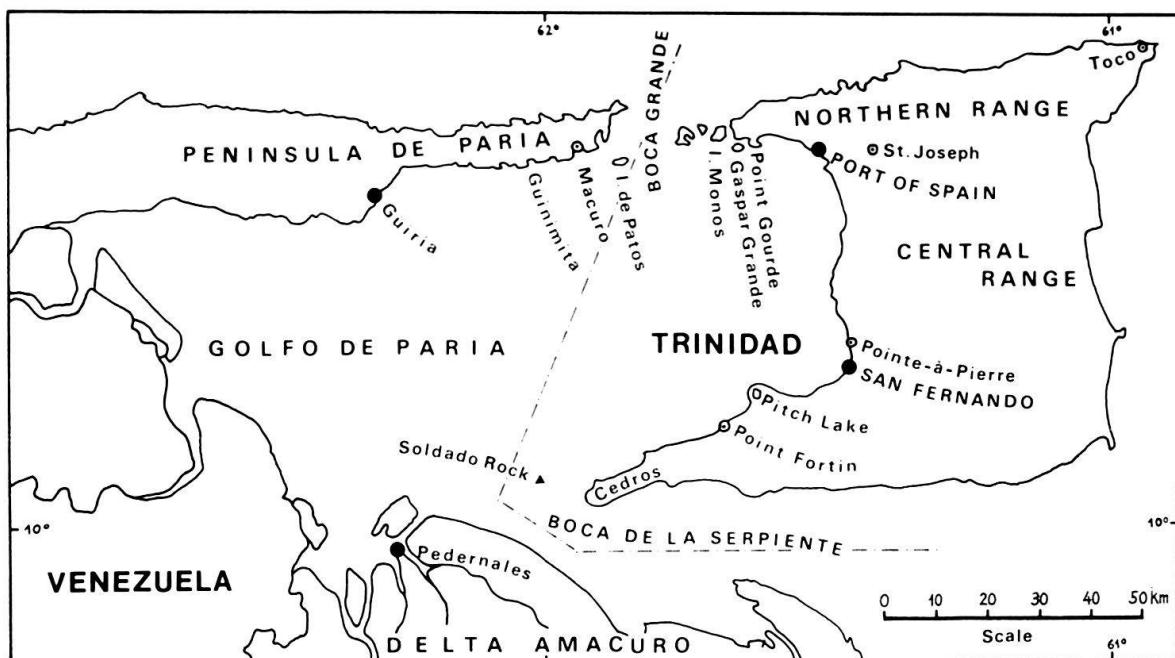


Fig. 1. Geographical position of Soldado Rock.

1912. Unfortunately, although the collection is now deposited in the Paleontological Research Institution at Ithaca, N.Y., the original correspondence and fieldbooks cannot be located. Samples of Larger Foraminifera studied by DOUVILLÉ, and echinoids described by JEANNET, were collected by F. Zyndel in March 1916.

The last paper on the geology of the Soldado Rock was published by KUGLER in 1938. Additional visits to the Rock were subsequently made by the present authors, as well as by T. F. Grimsdale, E. Lehner, Axel Olsson, H. H. Renz, J. B. Saunders, K. Schmid, etc., who all collected more samples. In February 1973, P. Jung and R. Panchaud of the Natural History Museum in Basel spent three days on Soldado Rock collecting additional fossils. On the advice of J. B. Saunders, bottom samples were taken in the waters West of the Rock by P. Percharde. The results of the study of all these samples demanded a revision of the former interpretation, particularly since the magnitude of reworking of older fossils, and their deposition in younger sediments, had previously been underestimated.

The great amount of additional material studied made it necessary to draw a new map showing the position of each sample (see Pl. I). For quick orientation the map is subdivided into squares of  $20 \times 20$  meters, marked and designated A-G and 1-6. In the text we have added the position of each locality to the observation number – for instance, K.3692, which can be found in square B-2, is referred to as K.3692 (B-2).

When visiting Soldado Rock in May 1946, considerable changes were noticed as compared with pre-war conditions. The Rock was used by the Royal Air Force for target practice with bombs and machine guns. Some bullets were found sticking in the rocks like belemnites. The formerly important localities on the southern tip, K.2948 to K.2950(C-5) were blown away, and so was the shallow cave, in its time known as the “abri-sous-roche” at K.10718(B-2).

Despite these changes and newly gained interpretations we shall here, for the sake of continuity, describe the formations and members along the same lines that

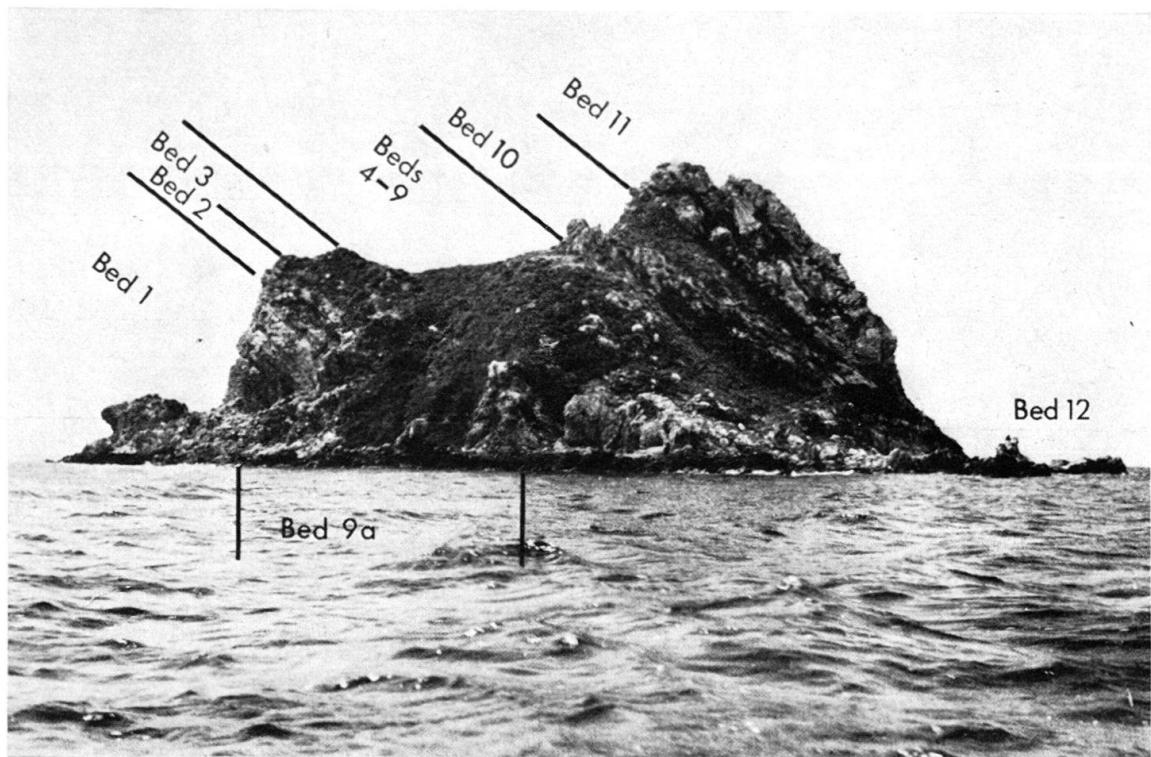


Fig. 2. Soldado Rock seen from the east (photo H. Stauffer 1933).

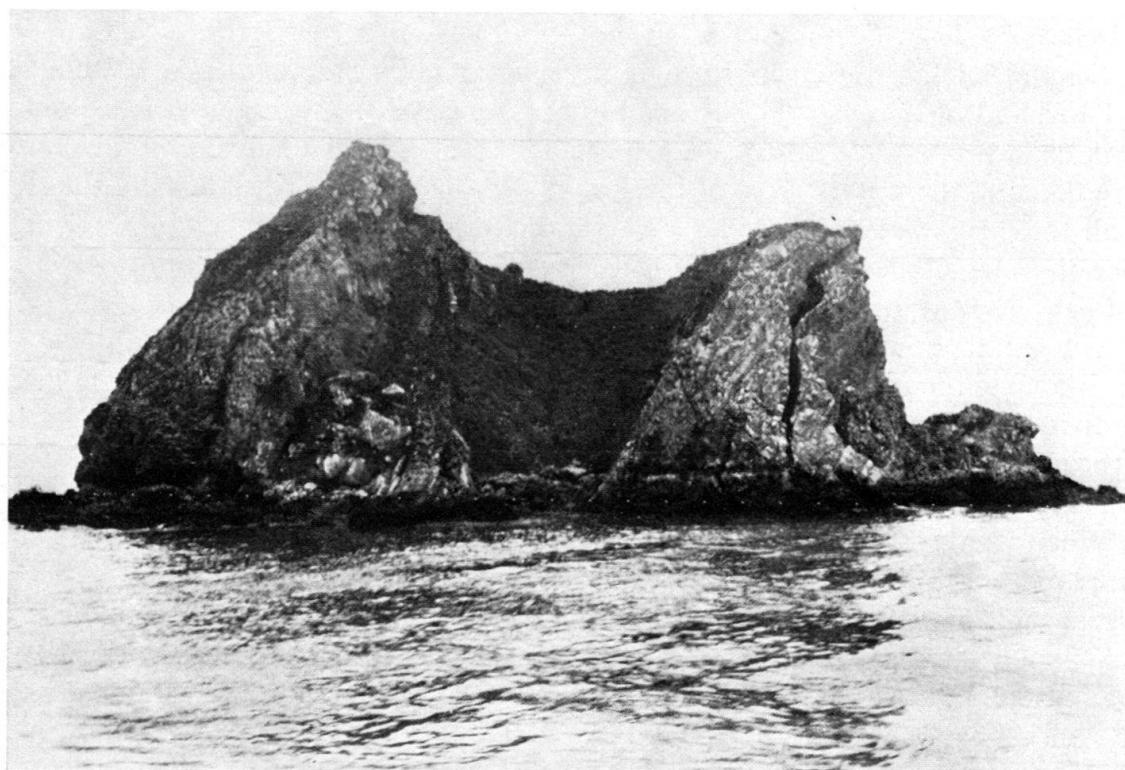


Fig. 3. Soldado Rock seen from the west (photo H. G. Kugler 1946).

were adopted in KUGLER's 1938 paper, in which, in a roughly South-North section, twelve different rock units were recognized. Amongst these, Beds 1-2 correspond with the level from which MAURY (1912) described the Paleocene mollusk fauna and which afterwards was called the "Soldado Formation", and Bed 11 includes her "Boca de Serpiente Formation". All these units are discussed in extenso in the following pages, whereby the senior author (H.G.K.) is responsible for the geological part of the present paper, and the junior author (C.M.B.C.) for the determination of the Larger Foraminifera and the age correlations based on them.

For the nomenclature of these fossils, used in the present text and fossil lists and in the Distribution Chart (see Pl. II), we refer to *Part 2* of this study on Soldado Rock. For technical reasons, publication of the paleontological descriptions had to be deferred to No. 3 of this same Volume of the "Eclogae". The new species and varieties, presented here as mere "nomina nuda", will then be fully established and the necessity of creating a new generic name (*Helicosteginopsis*) for *Helicostegina soldadensis* GRIMSDALE will be clear.

## A. THE SOLDADO FORMATION

*Author of name:* MAURY (1925a, p. 42)

*Original reference:* MAURY (1912, p. 28-30): "Eocene fossils from Soldado Rock"

*Original description:* idem

### Bibliographic history

MAURY (1912) published the fauna of a section from Soldado Rock, studied and sampled by A. C. Veatch who recognized 8 beds, of which Beds Nos. 2 and 8 carried a molluscan fauna. MAURY (p. 28) stated: "The basal bed, No. 2, is an extremely hard, greyish to reddish limestone containing quantities of shells which have become an integral part of the rock, from which they have been brought into high relief by the erosive action of the waves that constantly beat upon them. This bed lithologically is the exact counterpart of Midway Eocene near Ripley (Mississippi), Fort Gaines (Georgia), and Clayton (Alabama). Some samples of these various localities and Soldado cannot be distinguished from one another, and this resemblance is still more striking when fragments of rock from these widely separated places contain the same fossils." MAURY described 44 species of mollusks, several of which (amongst others *Venericardia planicosta*) formed a firm base for her correlation; 22 species and 3 varieties were new, apart from a new subgenus and species: *Veatchia caroliniae*. Her complete list is given on page 375 of this paper.

MAURY (1913, p. 92-96) referred to her publication on the Paleontology of Trinidad. In a stratigraphical table she correlated the Midway fauna of Soldado Rock and Pernambuco with that of the Gulf States. A similar correlation she suggested for the next younger Lignitic fauna corresponding to the Nanafalian stage of Alabama. Both are brought into connection with a hypothetical land route between South America and Africa.

VAN WINKLE (1919, p. 19-23), from material collected by A. C. Veatch, described 7 new species of shells (see p. 376).

VAUGHAN (1919, p. 578) considered Bed 2 to be of Wilcox rather than Midway age.

KUGLER (1923) gave a new stratigraphic description of the beds exposed on Soldado Rock. His lower limestone group "A", estimated to be about 40 meters thick, is essentially a hard, crystalline rock with thick-shelled mollusks, and partly rich in glauconite. The uppermost layer, full of mollusks, such as *Venericardia planicosta* was identified with Bed 2 of MAURY. KUGLER considered the Soldado Rock to form part of a structure of which the nearby Pelican Rocks present the crestal region. The Pelican Rocks, situated between  $1/2$  and 1 mile South of Soldado Rock, consist of almost N-S directed masses of marlstone, then thought to be of Late Cretaceous age (we now know that they are